

## SSLP115 - Computation of the rate of energy restitution of a disc fissured in the presence of initial stresses

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### Abstract

This test makes it possible to validate the computation of rate of energy restitution by the method theta in the presence of a stress state initial not virgins.

A clamped and fissured disc is subjected to stress field initial opening crack. This stress field initial is identical to that generated by a heat gradient. The solution is identical to that obtained in the case of the thermal loading only, validating the taking into account of an initial state of stresses.

## 1 Problem of reference

### 1.1 Geometry

One considers a disc of radius 100mm, embedded on its edges, and containing a horizontal crack of 23mm which one of the points is in the center of the disc. Figure 1.1 presents this geometry.

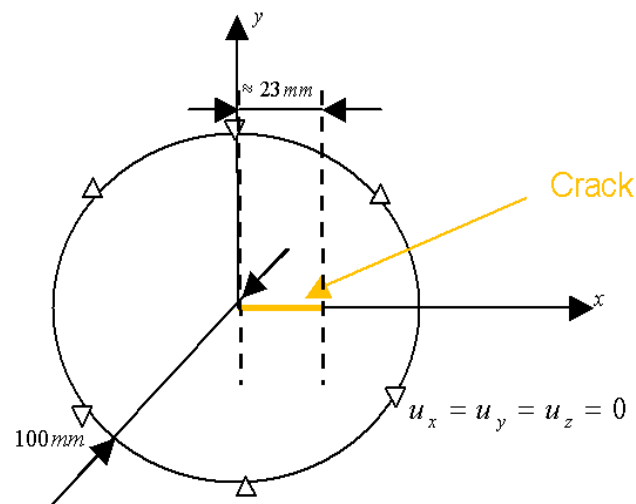


Figure 1.1 : Geometry of the disc

### 1.2 Properties of the material

Modulus Young:  $E = 210000 \text{ MPa}$   
 Poisson's ratio:  $\nu = 0,3$   
 Thermal coefficient of thermal expansion:  $\alpha = 10\text{E-}5 \text{ K}^{-1}$

### 1.3 Boundary conditions and loadings

the disc is completely embedded on its edge.

It is subjected to a stress field initial obtained by application of a thermal loading presenting a strong gradient according to the horizontal direction (see Figure 1.2 and Figure 1.3).

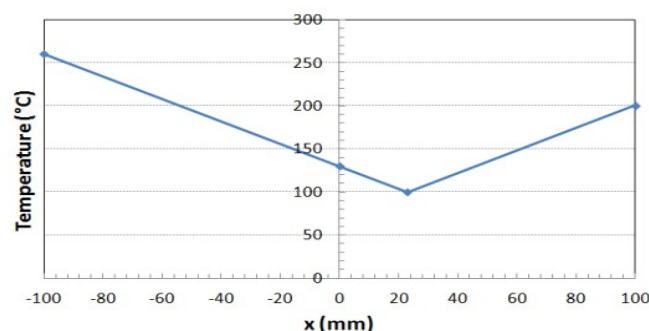


Figure 1.2 : Variation in temperature applied to the clamped disc.

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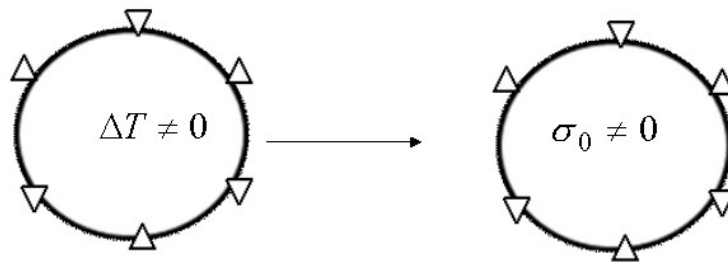


Figure 1.3 : Creation of the stress field initial.

## 1.4 Reference solution

the reference solution is that obtained by the application of the thermal loading directly on the disc fissured without initial state. Indeed, the behavior being elastic, the principle of superposition and the applies results in the presence of thermal loading without initial stresses and in absence of thermal with initial stresses are equivalent, as Figure 1.4 Figure 1.4.

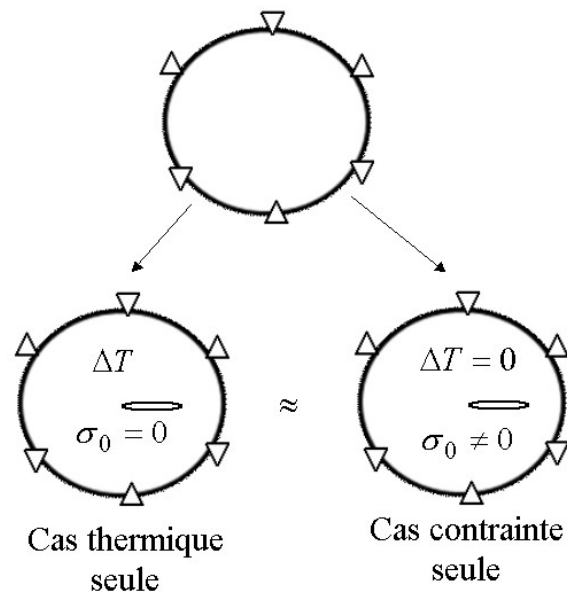


Figure 1.4 : Equivalence of the loadings.

## 2 Modelization A

### 2.1 Characteristic of the mesh

The mesh is quadratic radiant around crack; it is composed of 27670 nodes forming 9519 meshes including 100 triangles allowing the coarsening. Figure 2.1 and Figure 2.2 present the mesh used.

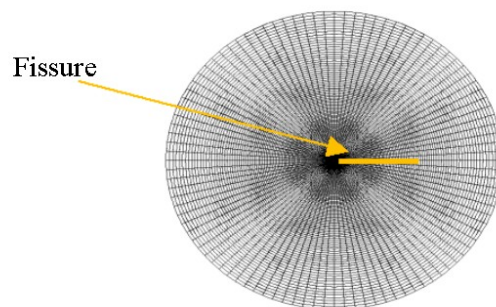


Figure 2.1 : Mesh of the disc.

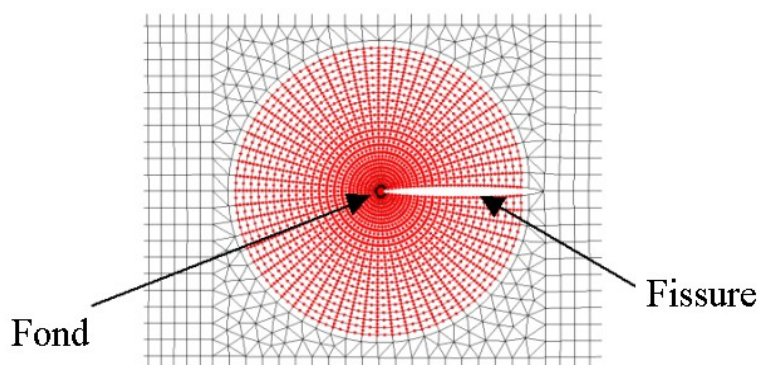


Figure 2.2 : Mesh: zoom on crack.

### 2.2 Computations carried out

In order to test various opportunities given by the command `CALC_G`, several configurations of computations are implemented.

The first of reference is result obtained by thermal loading without initial state.

The others result from computation with initial state without thermal loading; they differ by the type of stress field initial provided to command `CALC_G` : at the points of gauss, with the nodes by element or the nodes.

### 2.3 Quantities tested and Quantities

#### 2.3.1 results tested:

One result tests the value of the rate of energy restitution of the operator. They all must be equal except for a weak tolerance.

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## 2.3.2 Results:

Test of the stress intensity factors:

Identification	Reference	Tolerance
CALC_G		
$G$ resulting from thermal computation	55.36	0.10%
$G$ To Gauss points (GINNGA)	55.36	2.0%
$G$ with the nodes by element (GINELNO)	55.36	1.0%
$G$ to nodes (GINNO)	55.36	1.0%

## 3 Summaries of the results

the application of the principle of superposition shows that the computation of rate of energy restitution in the presence of initial state is correct.

It will be added that this same case gives the same results with the Abaqus software in its version 6.11.